SCHOTT North America, Inc.

Part number: A20960
Serial number:**122**

MaVi-S

Image Processing Stroboscope

User's Manual

and

Technical Reference

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CE

SCHOTT

Congratulations on Your Purchase
Thank you for purchasing the SCHOTT MaVi-S image processing stroboscope—a high-intensity light source for industrial image processing. Used with SCHOTT fiber optics and a camera, this instrument emits brief, intense light pulses that result in bright, clear, high-contrast images.

Used by properly trained professionals, and maintained as detailed in this user's manual, the SCHOTT MaVi-S image processing stroboscope will be a valuable addition to your facility.

Please carefully observe the safety warnings described throughout this manual, as the SCHOTT MaVi-S image processing stroboscope is an extremely powerful light source. Proper precautions must be observed at all times during its operation.

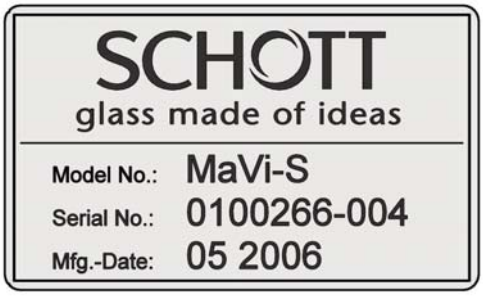
Product Warranty and Service
The warranty for this SCHOTT instrument complies with the regulations described in SCHOTT's General Terms and Conditions, as they exist at the time of your purchase. All product warranties are conditional on the instrument being used and maintained as described in this user's manual.

The product warranty does not apply to damage caused by incorrect usage, external forces or stresses, or failure to observe the operating instructions set forth in this manual. The warranty also is invalidated in the event that the equipment is tampered with, or modified without authorization.

To return this instrument to SCHOTT, always use the original packaging. If the original packaging is not used, SCHOTT reserves the right to inspect the instrument for transportation or handling damage when it arrives at the SCHOTT facility. Please mark the package as fragile and sensitive to cold temperatures. When returning your stroboscope, please include a detailed written explanation of the reason for the return, as well as a comprehensive description of any performance problems you are experiencing.

Trademarks
Please be aware that all brand and product names mentioned in this user's manual may be trademarks or registered trademarks of their respective companies or organizations.

Product Identification Label
MaVi-S Image Processing Stroboscope



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1.0 Safety Information

1.1 General Safety Information

1.1.1 Important Safety Notes

Please read this user's manual before using the SCHOTT MaVi-S image processing stroboscope. It will provide you with important information regarding the proper use of this instrument, as well as important information about safety. This knowledge will protect users, as well as prevent damage to the instrument. Please pay particular attention to the basic safety information included in Chapter 1, as well as the information on proper installation, operation, and maintenance contained in Chapters 2 and 3.

Please keep this user's manual in a safe place, and make it available to people who are using the SCHOTT MaVi-S stroboscope. Never pass the instrument on to a new user without also passing on the user's manual.

In this manual, the following safety and warning formats are used:

- **NOTE:** This indicates an action required to simplify the use of the instrument.
- **CAUTION:** This indicates that a potential hazard may exist that would result in damage to the instrument, and identifies the source of the danger.
- **WARNING:** This indicates a potential personal safety risk that could result in death or serious injury; the source of the danger is identified in each case.

1.1.2 Intended Use

The SCHOTT MaVi-S image processing stroboscope is intended for use in an industrial environment. It may only be used within the parameters defined in the technical specifications; please refer to Chapter 4 of this user's manual.

Safe and proper operation of this instrument depends on correct and appropriate transportation, handling, and storage, as well as the ongoing careful operation of the instrument, according to the instructions in this user's manual.

When assembling, installing, and operating the instrument, all users must strictly adhere to the safety and accident-prevention guidelines contained within this manual.

1.1.3 Qualification

This instrument may only be operated by users who are familiar with high-intensity imaging equipment, and who have received special instruction in the proper use of xenon flashlamps. Please pay particular attention to the information on the safe handling of xenon flashlamps found in Section 1.2 of this user's manual.

Expert maintenance and repair work may only be carried out by SCHOTT, or by qualified personnel who are authorized by SCHOTT to perform such tasks. Users should never attempt their own instrument repairs.

1.1.4 Disposal
Instruments that are no longer in use must be disposed of according to local regulations, unless otherwise provided for by SCHOTT.

1.2 Safe Handling of Xenon Flashlamps

1.2.1 Flashlamp Safety Information
The SCHOTT MaVi-S image processing stroboscope is equipped with an extremely stable xenon flashlamp that is focused into the fiber optics using an ellipsoid reflector. The light emitted from the aperture of the stroboscope, and from the fiber optics, is therefore extremely intense. When working with xenon flashlamps, users must take special precautions to ensure that this intense light does not enter the eye.

Due to its extreme brightness and high frequency, stroboscopic light can lead to seizures or blackouts in people who are photosensitive or have an epileptic condition. For this reason, the stroboscopic light should be shielded to the greatest extent possible.

To provide maximum user safety while the instrument is operating, the following precautions have been taken:

- SCHOTT instruments generally comply with the standards EN 60825-1 (DIN VDE 0837) and CFR 1040.10 (US), respectively.
- The aperture on the front panel of the instrument is covered by protective glass with an infrared filter. This safeguards users against splinters of glass that may result from a xenon flashlamp exploding.

1.2.2 Flashlamp Safety Precautions
Please observe the following safety precautions related to xenon flashlamps when using the stroboscope:

- Only qualified and fully trained users should be entrusted with setting up the instrument, adjusting it, and operating it.
- Avoid looking directly into the high-intensity stroboscopic light with the naked eye, or with the aid of mirrors or optical instruments. This applies not only to the direct flash from the instrument, but also to any light emitted from the fiber bundles and fiber-optic adapters used with the instrument.
- Only switch the stroboscope lamp on when you need to use it as a light source.
- Always switch the stroboscope lamp off before positioning and configuring the stroboscope.
- Only operate the stroboscope with the fiber optics connected, and shield the illuminated area completely from view.
- Ensure that general lighting levels are high when you are working on an active, unshielded stroboscope, in order to minimize the difference in the brightness level between the stroboscopic light and the general facility in which you are working.

WARNING—Danger from high-intensity light: Do not use any reflective tools, wear a watch, or otherwise promote light reflection when you are working near the beam path of the lamp.

WARNING—Danger from exploded splinters: The xenon flashlamps used in the MaVi-S stroboscope are under pressure and can explode.

WARNING—Danger from electrical current: The instrument housing should never be opened by users; doing so risks personal injury. In the event that your xenon flashlamp needs to be changed, please contact your local SCHOTT representative to identify a SCHOTT repair house that can safely make this change.

1.3 Electrical Safety

1.3.1 Electrical Safety Information

The SCHOTT MaVi-S image processing stroboscope complies with the electrical protection class 1 in accordance with the EU directive 73/23/EEC (low-voltage directive) and the protection rating IP40 (protection against solids > 1 mm, no protection against water). With correct power connection and appropriate use of the instrument for its intended purpose, user exposure to electrical current is prevented by its closed, grounded metal housing. This instrument complies with the EU directive 89/336/EEC (EMC directive) and is accordingly fail-safe (please refer to Section 4.1 and Appendix B of this user's manual).

1.3.2 Electrical Safety Precautions

Please observe the following electrical safety precautions when using this instrument:

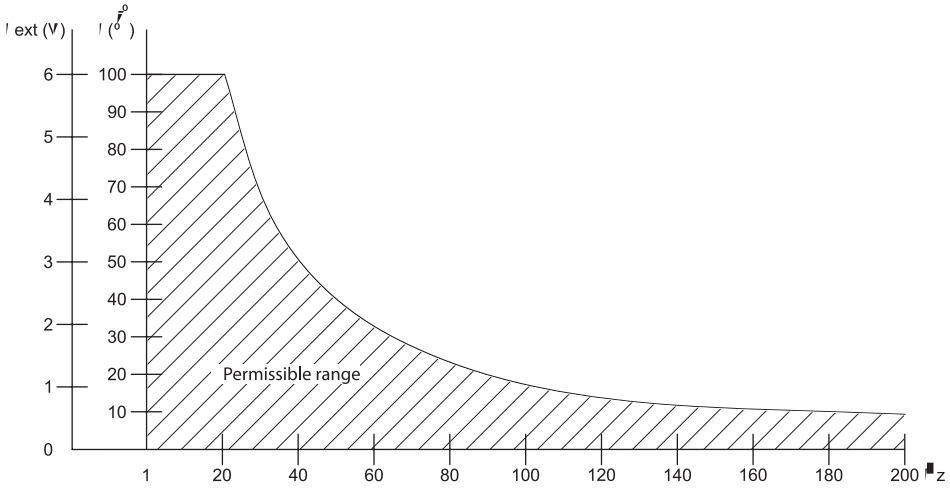
- The stroboscope may only be connected to AC systems of 50/60Hz with a nominal voltage in the range of 100V to 260V, using a three-pin main power cable with a grounded protective conductor.
- Defective fuses may only be replaced by fuses of the same type, and with the same rating. For more information on fuse replacement, refer to the product information found on the back of the instrument, as well as Chapter 4 of this user's manual.
- The instrument must not be operated with an open housing; users should not open the housing.

WARNING—Danger from electrical current: The instrument housing should never be opened by users. Expert maintenance and repair work—which includes changing xenon flashlamps—may only be carried out by SCHOTT, or by a qualified SCHOTT repair house. Please contact your local SCHOTT representative for more information.

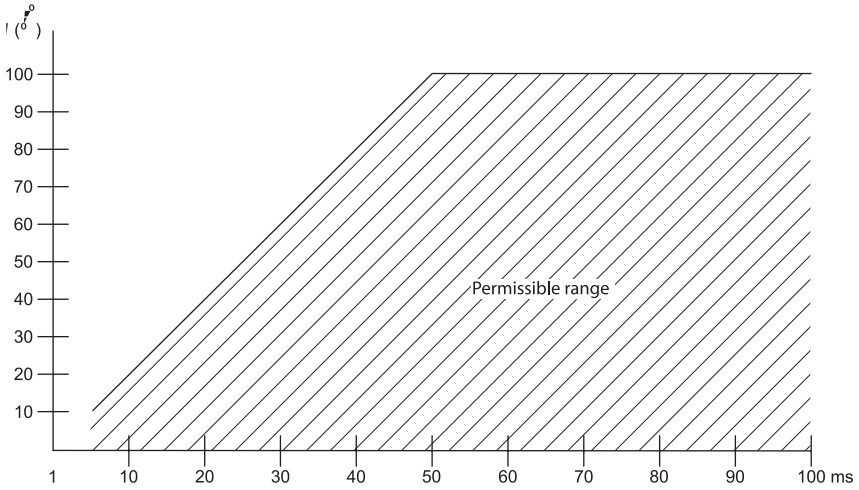
1.3.3 Overload Protection

The energy for the stroboscope lamp is buffered in a capacitor block of 13µF/600V. In conjunction with certain frequency intensity combinations, this capacity can lead to impermissible power dissipation of the xenon flashlamp. A function of the processor, the Safety Area Control, prevents such impermissible parameter combinations.
If values are entered which lead to impermissible power dissipation at the frequency limit set, then the instrument will not accept these values. The permissible value ranges are shown in the figures below.

CAUTION—Danger from overloading: If you control the instrument externally via the BNC jack J4 – Intensity Ref, please note that the instrument's overload protection feature is not active. In this case, you must strictly observe the frequency values shown below in order to protect against overload.



Intensity I = f (Frequency)



Intensity I = f (Burst Separation)

2.0 First Steps

2.1 Product Description

The SCHOTT MaVi-S image processing stroboscope is a light source for industrial image processing. Used in combination with SCHOTT fiber optics and your camera, the stroboscope's extremely brief and intense light pulses create bright, high-contrast images.

These light pulses are generated by an extremely stable xenon stroboscopic flashlamp; the emitted light is focused into the fiber optic cable using an ellipsoid reflector.

2.2 Unpacking and Inspection

The stroboscope arrives with the following components:

- MaVi-S image processing stroboscope
- Main power cable

Please follow these steps when unpacking the product components:

1. Check the packaging for signs of inappropriate handling during transportation.

2. After unpacking, check all components for external damage (scratches, loose screws, etc.).

3. In the case of a delivery error, product damage, or missing parts, please contact your local SCHOTT representative immediately, providing the serial number of the instrument. Serial numbers and identification labels can be found on the back panel of the instrument, as well as on the front cover of this user's manual.

4. Retain the original packaging, in case you have to return the instrument to SCHOTT in the future.

2.3 Getting Started

2.3.1 Installation

The SCHOTT MaVi-S image processing stroboscope should not be set up in a temporary or provisional position. The instrument should be mounted securely and permanently. To install your new SCHOTT MaVi-S image processing stroboscope, please follow the steps below.

1. Using the drill holes on the instrument's bottom panel as a guide, mount the instrument onto a suitable level substrate, either vertically or horizontally.

2. Connect the SCHOTT fiber optics to the aperture on the front panel of the stroboscope.

3. Connect the main power cable to the back of the stroboscope and to a grounded electrical socket.

2.3.2 Main Power Connection

The main voltage input of the SCHOTT MaVi-S image processing stroboscope is set up as a wide range input connection, which can be connected to all main voltages with nominal values in the range of 100V to 260V. Defective fuses may only be replaced by fuses of the same type, and having the same rating. For more information on fuse replacement, refer to the product information found on the back of the instrument, as well as Chapters 3 and 4 of this user's manual. Please note that both fuses are active, and both must be checked if there is a problem with fuse operation.

2.3.3 Opening the Instrument

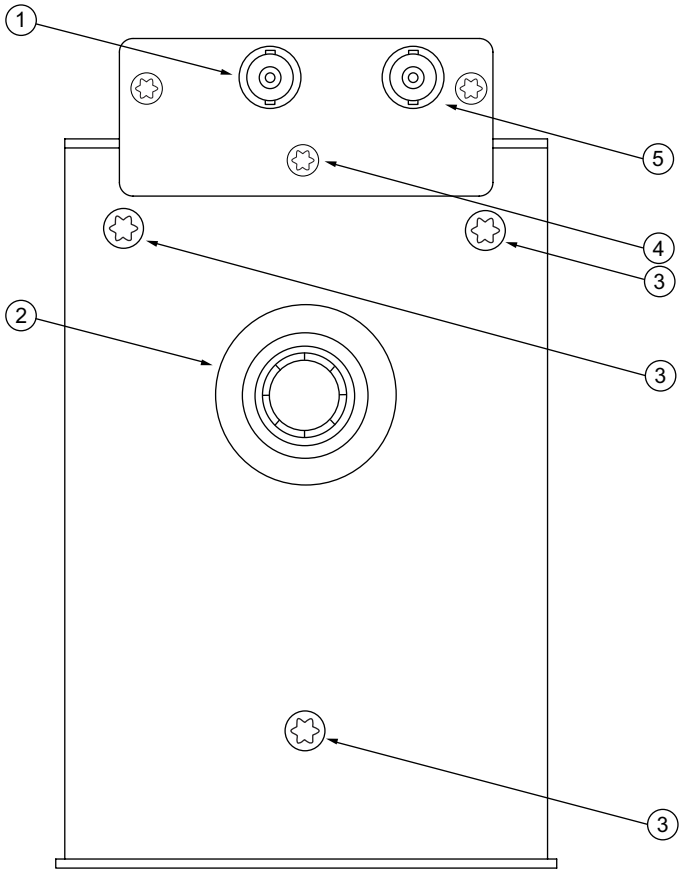
The stroboscope housing should only be opened to change the lamp. This is an expert task that can only be carried out by SCHOTT, or by qualified personnel who are authorized by SCHOTT to perform such tasks. Users should never open the stroboscope housing; doing so can cause personal injury and will invalidate the product warranty.

WARNING—Danger from electrical current: The instrument housing should never be opened by users. Expert maintenance and repair work—which includes changing xenon flashlamps—may only be carried out by SCHOTT, or an authorized SCHOTT repair house. Please contact your local SCHOTT representative for more information.

2.4 Control Elements of the Stroboscope

2.4.1 Front Panel

The front panel of the SCHOTT MaVi-S stroboscope is shown in the figure below.



Front view of the stroboscope

1. Analog input **J4 – Intensity Ref** (BNC jack)
   Signal input for external control of flash intensity
   (See Section 4.3)

2. **Light aperture** (fiber connection with end stop)
   Connector for fiber-optic adapter

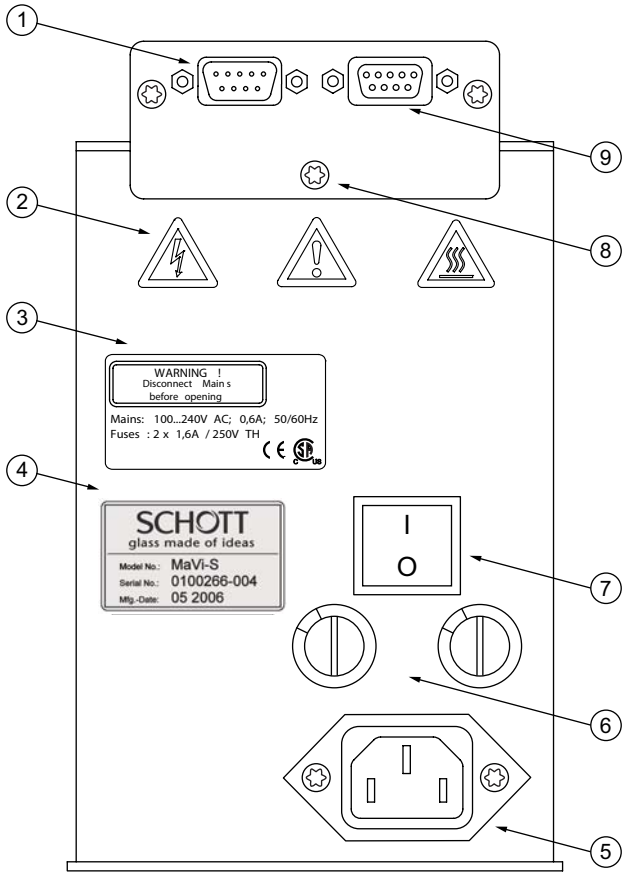
3. **Adjustment screws**
   Used only for servicing purposes

4. **Fixing screw**
   Used to secure the control panel

5. Analog input **J3 – Trigger** (BNC jack)
   Signal input for an external trigger signal
   (See Section 4.3)

2.4.2 Back Panel

The back panel of the MaVi-S image processing stroboscope is shown in the figure below.



Rear view of the stroboscope

1. RS232 interface output **J2 – RS232** (9-pin Sub-D plug)
   Interface output used to network several instruments
   (See Section 4.4)

2. **General warning labels**

3. **Power connection warning labels**
   Labels with technical information on fuses and main power connection

4. **Product identification label**
   This label includes the serial number of the instrument, as well as other information

5. **Main power connection** (socket for standard power cord)
   The main voltage input is a wide range input

6. **Fuse holders**
   Use only main fuses 1.6A/slow-blow fuses, regardless of the main voltage. Both fuses are active, and both must be checked if there is a problem with fuse operation. Use extreme caution when replacing fuses. For more information on fuse replacement, refer to Chapters 3 and 4 of this user's manual.

WARNING!—Danger from electrical current: The instrument housing should never be opened by users. Expert maintenance and repair work—which includes changing xenon flashlamps—may only be carried out by SCHOTT, or by a qualified SCHOTT repair house. Please contact your local SCHOTT representative for more information.

NOTE: Before checking the fuses, always ensure that the main power connection is turned off.

7. **Main power switch**
   This switch disconnects the stroboscope from its main power source (position O) and is used to turn off the instrument in case of danger.

8. **Fixing screw** for the control panel

9. RS232 interface input **J1 – RS232** (9-pin Sub-D jack)
   Interface input used for communicating with a personal computer, or networking several instruments
   (See Section 4.3)

3.0 Operation

3.1 Turning On and Off

3.1.1 MaVi-S Stroboscope

The MaVi-S image-processing stroboscope is turned on via the main power switch on the back of the instrument (the "I" position). After it is switched on, the current firmware version briefly appears in the LED display. Then the operating status most recently used is automatically restored. The settings that were last selected are maintained, even if the instrument has been disconnected from electrical power for a long time.

3.1.2 Xenon Flashlamp

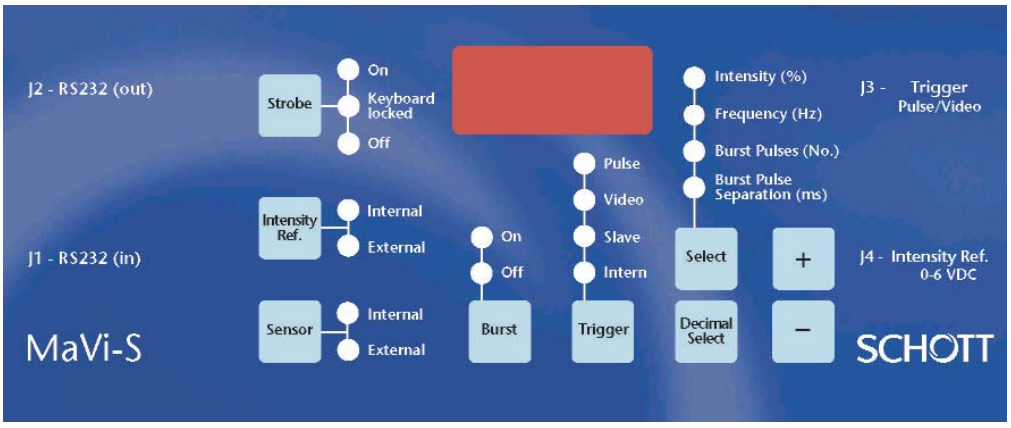
The MaVi-S xenon flashlamp is controlled via the Strobe key. When the flashlamp is activated, the LED display will read "On." When the lamp is turned off, the LED display will read "Off."

WARNING—Danger from high-intensity light: Avoid looking into the high-intensity MaVi-S light, or being exposed to it for long periods of time. Please refer to the safety information about working with xenon flashlamps found in Chapter 1 of this user's manual.

Input can be made via the control panel, whether the MaVi-S lamp is turned on or off, provided that the control panel has not been locked (please refer to Section 3.4).

3.2 Control Panel

The control panel for the SCHOTT MaVi-S stroboscope is shown in the figure below. By pressing a key, you adjust the stroboscope performance characteristic—e.g., trigger source—that is controlled by this key. As you adjust various settings, the corresponding LED will light up, so you know which performance characteristic, or parameter, you are currently changing.



Foil keyboard of the control panel

1. **Strobe** key
   This key is used to switch the stroboscope on and off (see Section 3.1, above). It has three positions:

On	This indicates that the stroboscope lamp is switched on.
Keyboard locked	This indicates that input is not possible, as the key lock has been activated (see Section 3.4).
Off	This indicates that the stroboscope lamp is switched off.

2. **Intensity Ref** key
   This key is used to choose between internal and external control of the flash intensity.

Internal	This indicates that flash intensity can be configured internally, via the control panel or the RS232 interface.
External	This indicates that the flash intensity can be configured via an external signal through the BNC jack J4 **–** Intensity Ref.

3. Four-digit **LED display**
   The LED display shows the current four-digit value set for the parameter that is being controlled via the Select key.

4. **Select** key
   This key is used to select one of the four adjustable parameters of the stroboscope. The value that is currently set for the selected parameter is shown in the four-digit LED display.

Intensity (%)	This indicates the value of flash intensity, measured as a percentage.
Frequency (Hz)	This indicates the frequency of the internal frequency generator, measured in hertz.
Burst Pulses (No.)	This indicates the current number of pulses in a burst.
Burst Pulse Separation (ms)	This indicates the time delay between the individual pulses of a burst, measured in milliseconds (10^{-3} seconds).

5. **Adjustment** keys +/–
   These keys are used to change the current settings to make the values higher (+) or lower (–).

6. **Decimal Select** key
   This key is used to select the position in the LED display that you want to change, by using the adjustment keys. The position that is currently selected flashes.

7. **Trigger key**
   This key is used to select one of the four possible trigger sources:

   Pulse This indicates that the trigger pulse will come from input J3 – Trigger.

   Video This indicates that the trigger source will be a video signal at the input J3 – Trigger.

   Slave This indicates that the trigger pulse will come from input J1 – RS232, connected to an upstream stroboscope.

   Intern This indicates that the trigger source is an internally generated trigger signal.

8. **Burst** key
   This key is used to choose between an individual flash and the burst function.

   On This indicates that the burst function is switched on.

   Off This indicates that the burst function is switched off, and that the instrument is operating as a simple stroboscope.

9. **Sensor** key
   This key is not used, and its settings have no effect on operation.

3.3 Functional Test

To carry out a first functional test on your new SCHOTT MaVi-S image processing stroboscope, please follow the steps below.

1. Turn on the stroboscope, using the main power switch on the back of the instrument (position I).

2. By repeatedly pressing the Trigger key, select the trigger source Intern. If this input is not accepted, and the message "Loc" appears in the LED display, then the control panel of the instrument is locked. In this case, switch the key lock to the "off" position, as described in Section 3.4.

3. By repeatedly pressing the Intensity Ref key, select the reference option Internal.

4. By repeatedly pressing the Strobe key, switch the stroboscope lamp on (LED adjacent to the strobe button will light).

The stroboscope should now emit stroboscopic light.

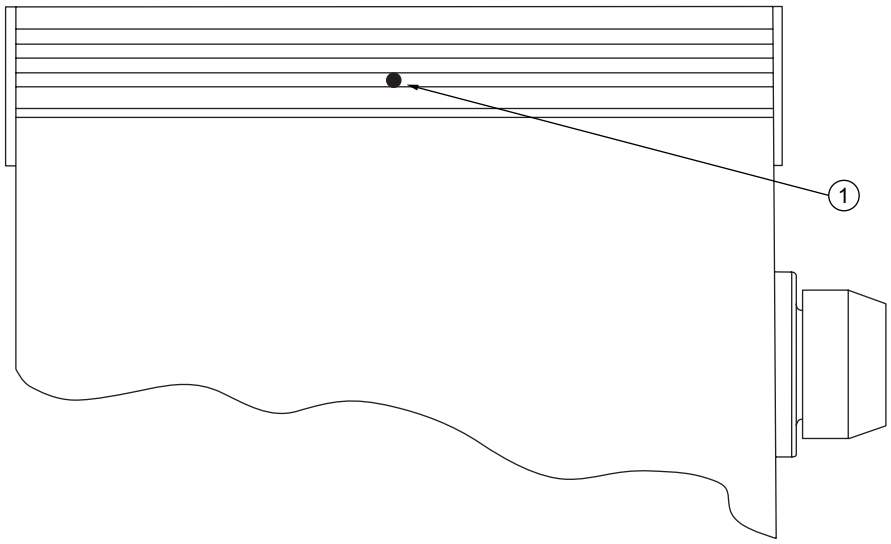
If the functional check was successful, you can now use the stroboscope as described in the following sections of this user's manual.

If any errors occur during the functional check, contact your local SCHOTT representative for assistance.

3.4 Locking the Control Panel

The MaVi-S stroboscope can be locked, in order to prevent unintentional changes to the settings. The button for locking the control panel is inside the pinhole opening at the side of the control panel. (See figure below.)

Use a thin, non-metallic object to press the button inside the pinhole opening (labelled "1" in the figure above) located at the side of the control panel. When this button is



Side view of the MaVi-S stroboscope, showing the opening for locking the control panel

pressed, the instrument is switched between two states: locked and unlocked. When the keys are locked via this button, the LED display on the control panel that is labelled "Keyboard locked" will light up. If any key is pressed on a locked control panel, the message "Loc" will appear in the LED display.

Please note that it is still possible to control the instrument via the RS232 interface, even if the control panel is locked. See Appendix A for more information.

3.5 Setting the Frequency Limit

Before configuring the stroboscope, select a frequency limit that reflects the highest expected frequency at which the instrument will be operating.

The energy for the stroboscopic lamp is buffered in a capacitor block. The capacity of this block can be exceeded if the combined limits of frequency and intensity exceed the permissible operating range. The Safety Area Control function (see Section 1.3) uses the

frequency limit entered to calculate the range of acceptable values for both the intensity and the pulse frequency in a burst, and blocks the strobe from operating outside the acceptable range.

To set the frequency limit, please follow these steps:

1. Press and hold the Select key. While holding it, press the + key repeatedly, until "FrLi" (for "frequency limit") appears in the LED display.

2. Release the Select key and, using the Decimal Select key, choose the position in the LED display that you want to change. The selected decimal position in the LED display will flash.

3. Change the selected position by using the +/– keys. Once this is set, the Safety Area Control function will only allow values that are within the permissible power loss range for all subsequent settings.

4. To quit the menu, press the Select key and, while holding it, press the + key repeatedly, until "End" appears in the LED display. Release the Select key.

Quitting the menu can also be accomplished by pressing both the Select key and the – key at the same time.

The frequency limit is adjustable from 20Hz to 200Hz. The values allowed by the Safety Area Control function correspond to the following system:

Minimum Value	Description	Maximum Value
8.0%	Intensity (internal/external setting)	(2000/FrLi) corresponds to 100%
1Hz	Frequency	FrLi
(1/FrLi)s	Pulse separation	250ms

NOTE: Settings that fall outside the permissible power loss range are automatically overwritten by the Safety Area Control function.

3.6 Setting Single Flash Frequency

The single flash frequency of the MaVi-S image processing stroboscope can be set from 1Hz to 200Hz. The step size is 0.1Hz. To change the single flash frequency, follow these steps:

1. Use the Select key to choose the LED "Frequency."

2. Use the Decimal Select key to select the position in the LED display that you want to change. The selected decimal position in the LED display will flash.

3. Change the value of the selected position using the +/– keys.

If the desired value cannot be set, this means that it falls outside the permissible performance values of the xenon strobe lamp, and is blocked by the Safety Area Control function. More information on this can be found in Section 1.3 and Section 3.5 of this user's manual.

3.7 Setting the Flash Intensity

3.7.1 External Reference

The flash intensity can be controlled using an external power supply. To do so, follow these steps:

1. Press the Intensity Ref key to select "External." The adjacent LED will illuminate. The instrument is now set to use the external intensity control.

2. Connect the external intensity reference signal to the BNC jack labelled J4 – Intensity Ref.

The MaVi-S stroboscope converts the applied voltage to a flash intensity between 8.0% and 100%. The strobe flash intensity depends on the reference diagram selected (see Section 3.7.2, below). The intensity value is shown in the LED display. The following relationship limits apply:

0.6V = 8%
6V = 100%

3.7.2 Reference Diagram

The relationship between the applied voltage and the resulting flash intensity is reflected in the reference diagram. You can choose between a linear reference diagram and a square one. The default setting for the MaVi-S instrument is the linear reference diagram.

To change the reference diagram, follow these steps:

1. Press the Select key and, while holding it, press the + key repeatedly, until "rEF" appears in the LED display.

2. Use the + key to change to the setting "Lin" (for the linear reference diagram) or "Quad" (for the square reference diagram).

3. To exit the menu, press and hold the Select key. While holding the Select key, press the + key repeatedly, until "End" appears in the LED display. Release the Select key.

You can also exit the menu by pressing both the Select key and the – key simultaneously.

The reference diagram has now been selected, and immediately becomes applicable to the external reference.

3.7.3 Internal Reference

The flash intensity can also be controlled directly by the MaVi-S stroboscope, using the control panel. To do so, follow these steps:

1. Use the Intensity Ref key to select "Internal" mode. The adjacent LED will illuminate. The instrument is now set to the internal intensity control mode.

2. Use the Select key to choose the LED "Intensity." The intensity value that is currently set will appear in the LED display.

3. Use the Decimal Select key to choose the position in the LED display that you want to change. The selected decimal position in the LED display will flash.

4. Change the selected position with the aid of the +/– keys.

The intensity is adjustable from 8.0% to 100%. The step size is 0.1%. A change does not become effective until the first time the flash condenser is reloaded. This occurs following the second flash after the change has been made.

If the desired value cannot be set, then it is outside the permissible range of values for the xenon lamp, and is blocked by the Safety Area Control function. More detailed information can be found in Section 1.3 and Section 3.5 of this user's manual.

NOTE: The charge level of the flash condenser is at a random level immediately after the MaVi-S stroboscope is switched on. Therefore, the first flash may be of a significantly higher intensity than the setting shown on the control panel.

3.8 Setting a Trigger

There are four different ways to trigger the MaVi-S xenon flashlamp: external pulse, external video, external slave, or internal trigger. Every trigger impulse results in a flash. If the MaVi-S stroboscope is operating in burst mode (see Section 3.9), then every trigger impulse will set off a burst of flashes.

3.8.1 External Triggers

To set one of the three external trigger options (pulse, video, or slave), follow these steps:

1. Use the Trigger key to select the external trigger source from these three options:

Pulse Trigger using a pulse (rising edge)
Video Trigger using a video signal
Slave Trigger using the signal of an upstream MaVi-S (see Section 3.14)

2. Connect the appropriate external trigger signal:

Pulse Impulse into the BNC jack J3 – Trigger
Video Video signal into the BNC jack J3 – Trigger
Slave Trigger output signal of the upstream MaVi-S into the Sub-D jack J1 – RS232 (in)

With a pulse trigger, the rising edge of the signal pulse is used. With a video trigger, the vertical trigger signal is filtered out of the video signal (please see Chapter 4).

3.8.2 Internal Trigger

If required, the MaVi-S instrument can also generate a trigger signal internally, corresponding to the single flash frequency (see Section 3.6). To choose an internal trigger, use the Trigger key to select the "Internal" mode. The adjacent LED will illuminate.

A trigger output signal is then also available via the BNC jack J2 – RS232 (out) to synchronize additional MaVi-S instruments operating in slave mode. The frequency of the trigger output signal corresponds to the flash frequency setting.

3.8.3 Trigger Delay

Users can also set a time delay between the trigger signal and the stroboscopic flash. To create such a delay, simply follow these steps:

1. Press and hold the Select key. While holding it, press the + key repeatedly until "dELY" appears in the LED display.

2. Release the Select key, and then use the Decimal Select key to select the position in the LED display you want to change. The selected position in the LED display will flash.

3. Change the selected position, using the +/– keys.

4. To exit the menu, press and hold the Select key. While holding it, press the + key repeatedly, until "End" appears in the LED display. Release the Select key.

You can also exit the menu immediately by pressing both the Select key and the – key simultaneously.

The delay time between the trigger signal and the corresponding flash can be set between 0.01% and 99.99%. The step size is 0.01%, and a single step corresponds to 0.326µs. The following limits are given:

Minimum delay time = 0.326µs (10^{-6} seconds)
Maximum delay time = 3.254ms (10^{-3} seconds)

3.9 Setting the Burst Function

The MaVi-S image processing stroboscope also features a burst function.

To switch on this feature, use the Burst key to select "Burst" mode. The adjacent LED will read "On." The instrument has now been switched from single flash mode to burst mode.

3.9.1 Burst Frequency

Users can customize the burst frequency of the MaVi-S stroboscope. To do so, follow these steps:

1. Use the Select key to choose "Frequency." The adjacent LED will illuminate. In the LED display, the current setting for the frequency of bursts is displayed.

2. Use the Decimal Select key to select the position in the LED display that you want to change. The chosen position in the LED display flashes.

4. Change the selected position, with the aid of the +/– keys.

If the desired value cannot be set, then it falls outside the permissible performance range of the xenon lamp, and is blocked by the Safety Area Control function. More detailed information can be found in Section 1.3 and Section 3.5 of this manual.

3.9.2 Number of Pulses

The MaVi-S stroboscope also allows users to define the number of pulses for a burst. Simply follow these steps:

1. Use the Select key to choose the LED "Burst Pulses (No.)." The LED display will show the number of pulses currently set for a burst.

2. Use the Decimal Select key to choose the position in the LED display that you want to change. The selected position in the LED display will flash.

3. Change the value in the selected position with the +/– keys. The number of pulses can be adjusted from 1 to 250.

3.9.3 Pulse Separation in the Burst

Users may also want to create a pulse separation when using the burst feature. This can be accomplished via the following steps:

1. Use the Select key to choose the LED "Burst Pulse Separation (ms)." The LED display shows the current separation between the pulses, in milliseconds (ms).

2. Use the Decimal Select key to choose the position in the LED display that you want to change. The selected position in the LED display will flash.

3. Change the value in the selected position, using the +/– keys.

NOTE: The overall time period of the pulse package—which includes the pulse separation and the number of pulses chosen—must be within the set frequency period for the burst.

If the desired value cannot be set, then it is outside the permissible range of values for the xenon lamp, and is blocked by the Safety Area Control function. More detailed information can be found in Section 1.3 and Section 3.5 of this user's manual.

3.10 Reading and Resetting the Counter

3.10.1 Total Counter

The MaVi-S image processing stroboscope has two different counters for the flashes that have already been emitted. A static total counter records all of the flashes ever emitted by the instrument. This counter value is saved once per hour in the flash memory of the instrument.

To read this counter, follow these steps:

1. Press and hold the Select key. While holding it, press the + key repeatedly, until "FLSU" appears in the LED display.

2. Release the Select key. The number of all flashes generated by the instrument so far is shown in the LED display.

3. To exit the menu, press and hold the Select key. While holding it, press the + key repeatedly, until "End" appears in the LED display. Release the Select key.

You can also exit the menu quickly by pressing the Select key and the – key at the same time.

The counter reading in the LED display is exponential, from 00E0 to 90E9 (90×10^9). This counter reading cannot be deleted.

3.10.2 Resettable Counter

The resettable counter of the MaVi-S stroboscope records the number of flashes that have been emitted since the last reset. You can use this counter to estimate when the lamp will need to be changed. To read the counter, follow these steps:

1. Press and hold the Select key. Press the + key repeatedly, until "FLco" appears in the LED display.

2. Release the Select key. The LED display will show the number of flashes since the last reset of the counter.

3. To exit the menu, press and hold the Select key. Press the + key repeatedly, until "End" appears in the LED display. Release the Select key.

You can also exit the menu by pressing the Select key and the – key simultaneously.

To reset this counter to zero, proceed as follows:

1. Press and hold the Select key. Press the + key repeatedly, until "FLco" appears in the LED display.

2. Release the Select key. The LED display shows the number of flashes since the last reset of the counter.

3. Press the – key. The counter is reset to zero.

4. To exit the menu, press and hold the Select key. Press the key repeatedly, until "End" appears in the LED display. Release the Select key.

You can also press both the Select key and the – key at the same time in order to quickly exit the menu.

The counter reading in the LED display is exponential, from 00E0 to 90E8 (90×10^8).

3.11 Restoring the MaVi-S Default Settings

The MaVi-S can be returned to its default settings. These default settings are:

Intensity	100%
Frequency	1Hz
Number of pulses per burst	1
Separation between pulses in burst	100ms
Burst	Off
Trigger	Pulse
Intensity reference	External
Strobe	On

To restore these default settings, follow these steps:

1. Press and hold the Select key. Press the + key repeatedly, until "rES" appears in the LED display.

2. Release the Select key.

3. Keep the Strobe key pressed, and press the – key. The instrument is reset to its default settings.

4. To exit the menu, press and hold the Select key. Press the + key repeatedly, until "End" appears in the LED display. Release the Select key.

To exit the menu immediately, you can simultaneously press the Select key and the – key.

3.12 Changing Fuses

The holders for the fuses can be found on the back of the MaVi-S stroboscope (please refer to the figure on page 12). To check and change fuses, follow these steps:

NOTE: Before checking and/or replacing fuses, always ensure that the main plug is disconnected.

1. Turn off the instrument, using the main power switch on the back, and unplug the main power connection.

WARNING—Danger from electrical current: After switching the instrument off, wait for one minute to ensure that all the electric circuits of the MaVi-S stroboscope have discharged completely.

It is possible that the MaVi-S may flash a few more times after being unplugged, because the capacitor must discharge completely.

2. Turn the fuse holder counter-clockwise, using a flat-bladed screwdriver. Remove the fuse holder and the fuse from the instrument.

3. If the fuse is defective, exchange it with a fuse of the same type and with the same rating. You will find technical information on replacement fuses on the MaVi-S warning label on the back panel of the instrument (see figure on page 12). You can also refer to Chapter 4 of this user's manual.

4. Using the flat-bladed screwdriver, turn the fuse holder clockwise into the housing in order to replace it.

NOTE: Both fuses are active, and both must be checked if there is a performance issue.

3.13 Changing the MaVi-S Lamp

The xenon flashlamp of the MaVi-S image processing stroboscope needs to be changed at regular intervals. The xenon lamp has electrode material that is continuously vaporized by the arc and deposited on the inside of the lamp—causing the luminous efficiency over the life of the lamp to decrease. After approximately 10E8 flashes (100 million), the luminous efficiency falls to less than 70%, and the lamp should be changed.

Changing the xenon flashlamp requires opening the instrument housing, which could cause personal injury due to the high voltage associated with the flashlamp.

Opening the instrument housing can also invalidate the MaVi-S product warranty.

In the event that your lamp needs to be changed, please contact your local SCHOTT representative to identify a SCHOTT repair house that can safely make this change.

WARNING—Danger from electrical current: The instrument housing should never be opened by users. Expert maintenance and repair work—which includes changing xenon flashlamps—may only be carried out by SCHOTT, or by qualified personnel who are authorized by SCHOTT to perform such tasks.

WARNING—Danger from exploded splinters: The xenon flashlamps used in the MaVi-S stroboscope are under pressure and can explode.

3.14 Networking Several Stroboscopes (Master-Slave Function)

The MaVi-S image processing stroboscope from SCHOTT enables users to network their instrument with several other MaVi-S instruments. In fact, each MaVi-S can be connected in a master-slave function with up to nine other stroboscopes. To establish this instrument network, follow these steps:

1. Working with the master MaVi-S stroboscope, define all the necessary settings on this instrument.

2. Connect the socket J2 – RS232 (out) of the master MaVi-S stroboscope to the jack J1 – RS232 (in) of the next MaVi-S instrument (RS232 cable, 1:1).

3. Connect the socket J2 – RS232 (out) of this second MaVi-S to the jack J1 – RS232 (in) of the next MaVi-S instrument. Repeat this step for each MaVi-S stroboscope in use.

4. For each of the slave stroboscopes connected to the master MaVi-S, use the Trigger key to select "Slave" mode. The adjacent LED will illuminate.

5. Adjust all other settings of the slave instruments to match those of the master MaVi-S, especially the trigger delay (refer to Section 3.8).

The master-slave function only refers to the trigger signal. The first MaVi-S in the chain is the master MaVi-S, acting as the trigger source for the other MaVi-S instruments. All other settings have to be made individually for each MaVi-S stroboscope in the network.

3.15 Power Adjustment of Several Stroboscopes

For technical reasons, there are slight deviations in the xenon flashlamps and reflectors used in SCHOTT's MaVi-S image processing stroboscopes. These deviations can lead to varying levels of brightness across MaVi-S stroboscopes, even if the instruments have the same intensity setting. To balance these intensity differences across multiple instruments, an intensity adjustment may be necessary for each MaVi-S stroboscope.

A percentage value is set for the power adjustment, which determines the percentage of the power actually available to use for a flash, if the intensity on the instrument is set to 100%.

To make a power adjustment on two MaVi-S instruments, follow these steps:

1. Select one MaVi-S stroboscope as the reference instrument, and set its intensity to 100% (refer to Section 3.7 of this manual). The MaVi-S with the weaker intensity should be used as the reference instrument.

2. Measure the intensity of this reference instrument, using a light meter or associated image analysis software. This value will be used as a benchmark for all other MaVi-S instruments used in conjunction with this reference stroboscope.

3. Set the intensity of the second MaVi-S instrument to 100%, and measure its intensity.

4. Estimate the percentage to which the intensity of the second MaVi-S stroboscope needs to be reduced, in order to attain the same intensity level as the reference instrument.

5. Press and hold the Select key. Press the + key repeatedly, until "PoAd" appears in the LED display. The value that was previously set will be shown in the LED display.

6. Use the Decimal Select key to choose the position in the LED display that needs to be changed. The selected position in the LED display will flash.

7. Change the selected position, using the +/– keys.

8. Now measure the intensity of the second MaVi-S stroboscope, using a light meter or associated image analysis software. Compare this value to the intensity of the reference instrument measured in Step 2.

9. Repeat steps 4 through 8 until the intensity of the second MaVi-S stroboscope corresponds to the intensity of the reference instrument.

10. To exit the menu, press and hold the Select key. Press the + key repeatedly, until "End" appears in the LED display. Release the Select key.

You can also quickly exit the menu by pressing the Select key and the – key simultaneously.

3.16 Instrument Cleaning

The housing surfaces of the MaVi-S stroboscope can be cleaned using mild detergents or disinfectant solutions. Solvent-based cleaning products—including bleaches and acetone—should be avoided, along with abrasives.

NOTE: Before cleaning the instrument, switch it off and unplug the main power connection.

4.0 Technical Specifications of MaVi-S

4.1 Standards Applied

Electrical safety	IEC/EN 61010 (Safety requirements for electrical equipment for measurement, control, and laboratory use)
EMC	IEC/EN 61000 (EMC requirements on emission and immunity—electrical equipment for measurement, control, and laboratory use) Emission: FCC Class B IEC/EN 61000-6-3 Immunity: IEC/EN 61000-4-2 to 61000-4-6 and IEC/EN 61000-4-11
CSA-No.	LR 221779

4.2 General Data

4.2.1 Main Power Connection

Main voltage	100 – 260VAC
Power consumption	max. 75 VA
Fuses	1.6A/slow-blow
Protection class	1 (protective grounding)

4.2.2 Ambient Conditions

Operating temperature	32°F – 109.4°F (0°C – 43°C)
Storage temperature	-40°F – 194°F (-40°C – 90°C)
Relative humidity	max. 80%, non-condensing
Altitude of operating location	0 – 9842.5 feet (0 – 3000 meters) above sea level

4.2.3 Housing

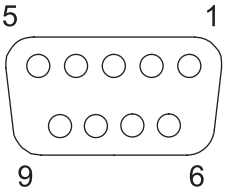
Protection rating	IP40
Instrument dimensions	4.33 in. x 7.87 in. x 7.28 in. (110 mm x 200 mm x 185 mm)
Base plate dimensions	4.33 in. x 7.48 in. x .08 in. (110 mm x 190 mm x 2 mm)
Weight	4.41 pounds (2 kg)

4.2.4 Sound Emission

Sound level	61dBA at 1 meter distance

4.3 Signal Inputs

J1 – RS232 (in)	9-pin Sub-D jack
Baud rate	9600
Data format	1 start bit, 8 data bits, 1 stop bit, no parity bit
Pin configuration	Looking at the jack from the outside:



Pin 1	N/A
Pin 2	transmitted data T x D (→)
Pin 3	received data R x D (←)
Pin 4	N/A
Pin 5	reference potential GND
Pin 6	N/A
Pin 7	Trigger input TTL
Pin 8	N/A
Pin 9	N/A

J3 – Trigger (pulse/video)	BNC jack
Voltage range	4 – 27V
Trigger level	2.2V
Input resistance	11.5kΩ
Compatibility	TTL (5V) SPS (24V) PAL/CCIR video signal

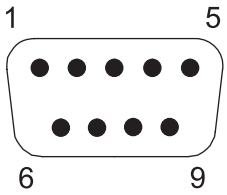
J4 – Intensity Ref	BNC jack
Voltage range	0 – 6VDC
Setting range	0.6V (≡ 8% intensity) – 6V (≡ 100% intensity)
Input resistance	40 kΩ

CAUTION—Danger from overloading: If you control the instrument externally via the BNC jack J4 – Intensity Ref, please note that the instrument's overload protection feature is not active. In this case, you must strictly observe the frequency values shown on page 8 of this manual, in order to protect against overload.

4.4 Signal Outputs

J2 – RS232 (out) 9-pin Sub-D plug

Baud rate	9600
Data format	1 start bit, 8 data bits, 1 stop bit, no parity bit
Pin configuration	Looking at the plug from the outside:

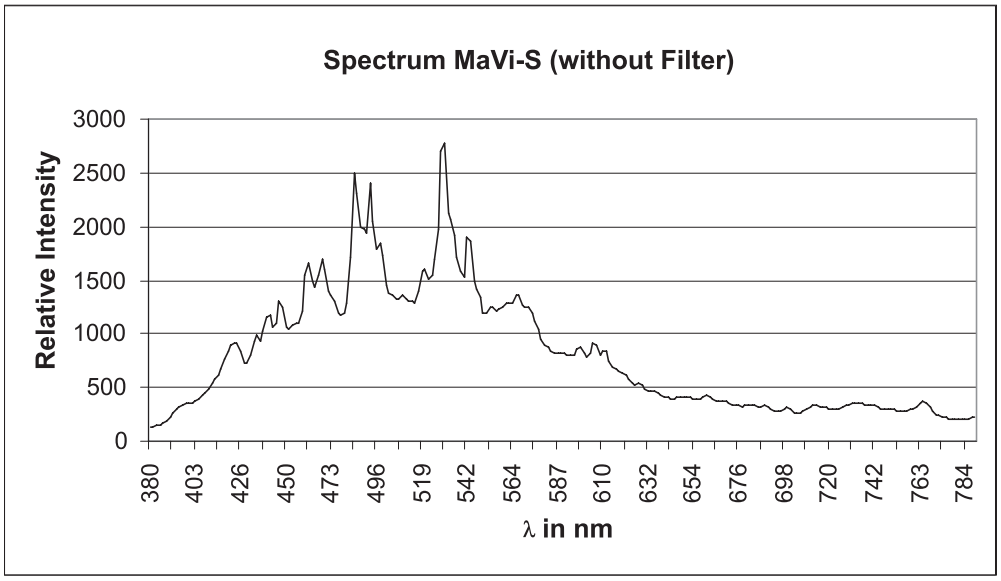


Pin 1	N/A
Pin 2	transmitted data T x D (→)
Pin 3	received data R x D (←)
Pin 4	N/A
Pin 5	reference potential GND
Pin 6	N/A
Pin 7	Trigger input TTL
Pin 8	N/A
Pin 9	N/A

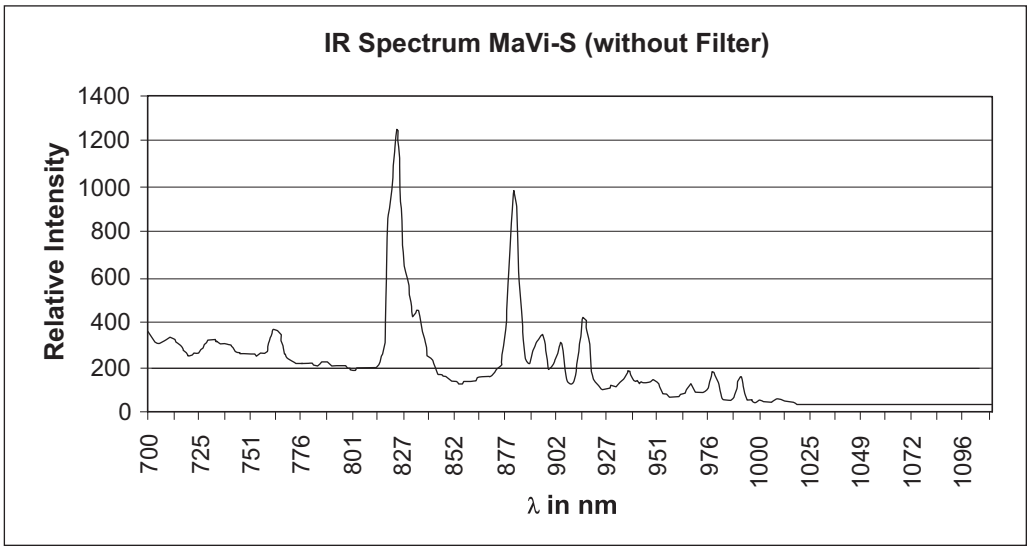
4.5 Xenon Flashlamps

Maximum energy	max. 2.16J electrical, at up to 20Hz
Frequency	max. 200Hz
Spectrum	approx. 300 – 1000nm
Pulse-to-pulse stability	typ. 1.5 – 2.5%
Service life	10E8 flashes (100 million)

The radiation spectra of the xenon flashlamps are shown in the figure below, and on page 32. They were captured in instruments without IR filter protection glass.



Visible spectrum of the xenon flashlamp



IR spectrum of the xenon flashlamp

Appendix A: Operation of Interface RS232

A.1 Configuration of the Interface

As an alternative to operating the SCHOTT MaVi-S image processing stroboscope using the instrument's control panel, all functions of the stroboscope can also be controlled via the RS232 interface.

The RS232 interface has the following configuration:

- 9600 Baud
- 1 start bit, 8 data bits, 1 stop bit
- No parity bit
- No hardware or software handshake

A.2 Setting the Instrument Address

In order to control several stroboscopes via the RS232 interface, each instrument must first have a unique instrument address assigned to it. To set an instrument address, follow these steps:

1. Press the Select key and, while holding it, press the + key repeatedly, until "Adr x" appears in the LED display ("x" stands for the instrument address).

2. Now use the adjustment keys +/– to set the required instrument address.

3. To quit the menu, press the Select key and, while holding it, press the + key repeatedly, until "End" appears in the LED display. Release the Select key.

Users can quit the menu immediately by pressing the Select key and the – key simultaneously.

A.3 Interface Commands

A.3.1 Syntax of the Interface Commands

When describing interface commands in this appendix, the square brackets [ ] and the spaces are not part of the command. They are used here simply to clarify and improve the readability of the individual parts of each command.

Each command must be confirmed with the Return key (↵).

Before the actual command, you will find the address of the specific MaVi-S instrument that the command will be applied to. If several instruments are being operated together, then the corresponding instrument addresses have to be strung together. For example, the command "37setint80↵" sets the intensity for the instruments 3 and 7 to 80%.

If no address is defined for the command, then the command will apply to all stroboscopes that are connected and networked at the time. Please note that all query commands allow only one instrument address to be given.

A.3.2 Commands to Define Settings

General Commands

Users can set the basic functions of the MaVi-S instrument—described in Section 3.1 through Section 3.7 of this user's manual—with the following commands:

Command	Function
[adr] stron ↵	Switches the stroboscope lamp on; input via the control panel is possible (refer to Section 3.1)
[adr] stroff ↵	Switches the stroboscope lamp off; input via the control panel is possible (see Section 3.1)
[adr] keyloc ↵	Locks all keys on the control panel of the instrument (see Section 3.4)
[adr] keyopn ↵	Unlocks all keys on the control panel of the instrument (see Section 3.4)
[adr] setint [data] ↵	Sets the intensity to the given value in %; value range is 8 – 100 (refer to Section 3.7)
[adr] refint ↵	Sets the instrument to internal intensity reference (see Section 3.7)
[adr] refext ↵	Sets the instrument to an external intensity reference via the BNC jack J4 – Intensity Ref (refer to Section 3.7 and Chapter 4)
[adr] setfre [data] ↵	Sets the frequency to the given value in Hz; value range is 1 – 200 and step size is 0.1 (see Section 3.6)
[adr] setref [data] ↵	Sets the required reference diagram (see Section 3.7) Possible values: 0 = Linear reference diagram 1 = Square reference diagram

Trigger Commands

SCHOTT MaVi-S users can select from four different trigger sources via the RS232 interface, by using the following commands:

Command	Function
[adr] tripul ↵	Sets the instrument to external trigger from a pulse (refer to Section 3.8)
[adr] trivid ↵	Sets the instrument to external trigger from a video signal (see Section 3.8)
[adr] trisla ↵	Sets the instrument to external trigger from an upstream instrument via the slave function (see Section 3.8)

[adr] triint ↵	Sets the instrument to internal trigger (see Section 3.8)

Users can also set a signal delay between the trigger and setting off the flash, by applying the following commands:

Command	**Function**
[adr] setdel [data]↵	Sets a time delay between the trigger signal and flash, expressed as a percentage; the value range is 0.01 – 99.99 (see Section 3.8)
[adr] setdelabs [data] ↵	Sets an absolute time delay between the trigger signal and setting off the flash in ns (10^{-9} seconds); value range is 0 – 3000000 and step size is 54 ns. Digital processing generates a rounding error of max. 54 ns.

Commands for the Burst Mode

Users can configure the MaVi-S instrument's burst mode via the RS232 interface by using the following commands:

Command	**Function**
[adr] buron ↵	Switches the burst mode on (refer to Section 3.9)
[adr] buroff ↵	Switches the burst mode off; the instrument then works in single flash mode again (see Section 3.9)
[adr] setpul [data]↵	Sets the number of pulses for a burst to the given value; value range is 1 – 250 (see Section 3.9)
[adr] setsep [data] ↵	Sets the separation between the pulses of a burst to the given value in ms (10^{-3} seconds); value range is 1 – 1000 (see Section 3.9)

Command for the Resettable Counter

The resettable counter of the SCHOTT MaVi-S stroboscope can be reset to zero by using the following command (refer to Section 3.10 of this user's manual):

Command	**Function**
[adr] resflc ↵	Resets the counter

A.3.3 Commands to Query Settings

SCHOTT MaVi-S users can also use the RS232 interface to send queries regarding the settings for a given instrument. Users can either check one setting, or send a query regarding all the instrument's settings.

Individual Settings Queries

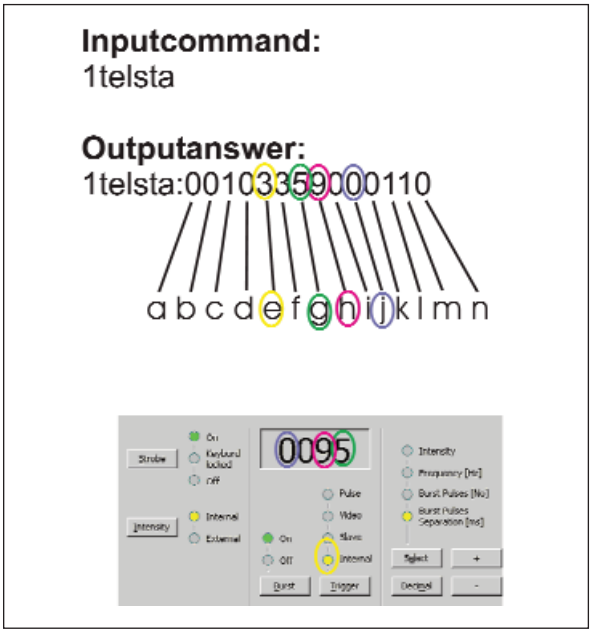
Users can query individual settings for a MaVi-S stroboscope via the RS232 interface by using the following commands. Please note that all query commands allow only one instrument address to be given.

Command	Function
[adr] telint ↵	Queries the flash intensity setting; answer is in the form: [adr] telint: [data] ↵ Possible values range from 8 to 100%
[adr] telfre ↵	Queries the single flash frequency setting; answer is in the form: [adr] telfre: [data] ↵ Possible values range from 1 to 200Hz
[adr] telpul ↵	Queries the set number of pulses in a burst, answer is in the form: [adr] telpul: [data] ↵ Possible values range from 1 to 250
[adr] telsep ↵	Queries the separation between the pulses of a burst; answer is in the form: [adr] telsep: [data] ↵ Possible values range from 1 to 1000 ms
[adr] teldel ↵	Queries the delay time set for the trigger; answer is in the form: [adr] teldel: [data] ↵ Possible values range from 0.01 to 99.99
[adr] telflc ↵	Queries the status of the resettable counter; answer is in the form: [adr] telflc: [data] ↵ Possible values are decimal numerals
[adr] telfls ↵	Queries the status of the total counter; answer is in the form: [adr] telfls: [data] ↵ Possible values are decimal numerals
[adr] telref ↵	Queries the reference diagram setting; answer is in the form: [adr] telref: [data] ↵ Possible values are: 0 = Linear reference diagram 1 = Square reference diagram
[adr] telver ↵	Queries the current firmware version; answer is in the form: [adr] telver: [MaVi-S flash, fv = y.z] ↵ "y.z" corresponds to the firmware version number

Total Settings Query

Users can query all settings of a MaVi-S stroboscope via the RS232 interface by using the following command; please note that only one instrument address can be given:

Command	Function
[adr] telsta ↵	Queries the overall instrument status; answer is in the form: [adr] telsta: [abcdefghijklmn] ↵



Format for total settings queries via the RS232 interface

The letters—which represent positions in the instrument's answer—take on different values, depending on the instrument's current status. The following is a key to the definitions of these values:

Letter/position	Value	Meaning
a	0	Stroboscope lamp is switched on.
	1	Stroboscope lamp is switched off; keys are locked.
	2	Stroboscope lamp is switched off; keys are released.
b	0	Flash intensity is controlled internally by the instrument.
	1	Flash intensity is controlled externally via the jack J4 – Intensity Ref.
c	0	No function assigned.
	1	No function assigned.
d	0	Burst mode is switched on.
	1	Burst mode is switched off.
e	0	External trigger is set, using a pulse signal at the BNC jack J3 – Trigger.
	1	External trigger is set, using a video signal at the BNC jack J3 – Trigger.

	2	External trigger is set, using a trigger signal from an upstream stroboscope through the jack J1 – RS232 (in).
	3	An internal trigger signal is set.
f	0	In the field Select, the LED "Intensity" has been chosen.
	1	In the field Select, the LED "Frequency" has been chosen.
	2	In the field Select, the LED "Pulse" has been chosen.
	3	In the field Select, the LED "Separation" has been chosen.
g	x	Value of the position 0 in the LED display (for the performance characteristic chosen in **f**)
h	x	Value of the position 1 in the LED display (for the performance characteristic chosen in **f**)
i	x	Value of the position 2 in the LED display (for the performance characteristic chosen in **f**)
j	x	Value of the position 3 in the LED display (for the performance characteristic chosen in **f**)
k	0	Value in the LED display has no decimal place.
	1	The decimal place in the LED is after position 1.
	2	The decimal place in the LED is after position 2.
	3	The decimal place in the LED is after position 3.
l	0	Control panel is locked.
	1	Control panel is not locked.
m	0	No position has been selected in the LED display.
	1	The position 0 has been selected in the LED display.
	2	The position 1 has been selected in the LED display.
	3	The position 2 has been selected in the LED display.
	4	The position 3 has been selected in the LED display.
n		No function assigned.

A.3.4 Commands to Link to Other Systems

The following set of commands will show MaVi-S users an exact replica of the current function of the keys on the instrument's control panel. It serves as an excellent basis for generating a graphic user interface, or another link into existing control systems. As with other queries, please note that only one instrument address can be given.

Command	Function
[adr] key [1] ↵	Corresponds to pressing the Strobe key once
[adr] key [2] ↵	Corresponds to pressing the Intensity Ref key once
[adr] key [3] ↵	Corresponds to pressing the Sensor key once
[adr] key [4] ↵	Corresponds to pressing the Burst key once
[adr] key [5] ↵	Corresponds to pressing the Trigger key once
[adr] key [6] ↵	Corresponds to pressing the Select key once
[adr] key [7] ↵	Corresponds to pressing the Decimal Select key once
[adr] key [8] ↵	Corresponds to pressing the + key once
[adr] key [9] ↵	Corresponds to pressing the – key once

As an alternative to the command [adr] key [6] ↵, the four possible settings of the Select key can also be chosen directly, by following this guide:

Command	Function
[adr] selint ↵	Selects the LED "Intensity," measured as a percentage
[adr] selfre ↵	Selects the LED "Frequency," measured in Hz
[adr] selpul ↵	Selects the LED "Burst Pulses," expressed as a number
[adr] selsep ↵	Selects the LED "Burst Pulse Separation," measured in ms

Appendix B: Declaration of Conformity

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